3. Data Sources

EPA uses readily available Agency and other databases, models, and reports to evaluate water quality effects. The following sections describe the various data sources that EPA used in this analysis.

3.1 Facility-Specific Data

EPA uses various sources for collecting data on CWT facilities. EPA obtains data through EPA site visits and sampling, responses to CWT questionnaires, comments to the 1995 proposal and 1996 Notice of Data Availability, and contacts with industry sources, regions and states. EPA uses this information to estimate many of the facility-specific parameters required for this analysis such as annual discharge volume, current pollutant loadings, and loadings associated with each regulatory option. EPA's data collection procedure is described in detail in chapter 2 of the technical development document.

For the CWT facilities which were identified through the WTI Questionnaire, EPA has discharge location information. For the others, EPA had to make some assumptions about their discharge locations. For direct dischargers, EPA assumes the adjacent water body is the receiving water. For indirect dischargers, EPA conducts an analysis to identify the appropriate publicly owned treatment works (POTW) that may receive the facility discharge. For others, EPA identifies the locations of CWT facilities or POTWs on receiving water bodies using USGS cataloging units and EPA stream segment (reach) numbers contained in either EPA's Permit Compliance System (PCS) or Industrial Facilities Discharge (IFD) database. If a reach number is not available in the EPA databases, EPA uses facility latitude/longitude coordinates to locate facility discharge points using EPA's Reach File 1 (RF1). For any indirect discharge facilities (those discharging to a POTW, not directly to a water body), EPA obtains the name, location, and design flow data for each affected POTW from a variety of sources including EPA's 1996 Clean Water Needs Survey database, IFD, and PCS.

EPA obtains the raw receiving water flow data from the USGS Daily Flow File. In all cases, EPA uses the closest flow gauge to estimate the flow rate at the point of facility discharge. EPA determines the average and low-flow statistics (e.g., the 7Q10 low flow) using the Water Quality Analysis System residing on the

Agency's NCC mainframe computer. EPA obtains Dissolved Concentration Potentials (DCPs) for estuaries and bays from the Strategic Assessment Branch of NOAA's Ocean Assessments Division (see Appendix A). EPA uses Critical dilution factors (CDFs) from the *Mixing Zone Dilution Factors for New Chemical Exposure Assessments* (USEPA, 1992b). If neither DCPs nor CDFs are available for a particular facility, EPA estimates a CDF based on best professional judgment and the dimensions, depth, and general flushing characteristics of the bay or estuary.

3.2 Information Used to Evaluate POTW Operations

As detailed in the chapter 7 of technical development document, EPA estimates the average percent removal for each pollutant of concern at well-operated POTWs (those meeting secondary treatment requirements) using data from a study of 50 well-operated POTWs and data from the Risk Reduction Engineering Laboratory (RREL). EPA uses inhibition values obtained from the *Guidance Manual for Preventing Interference at POTWs* (USEPA, 1987a) and from *CERCLA Site Discharges to POTWs: Guidance Manual* (USEPA, 1990) (see Table 3-1).

Whenever a range of values are obtained, EPA uses the most conservative value reported for activated sludge-based POTWs. For pollutants with no specific inhibition value, EPA uses a value based on compound type (e.g., aromatics).

EPA uses sewage biosolids regulatory levels[1], if available for the pollutants of concern (see Table 3-2). EPA uses pollutant limits established for the final use or disposal of sewage biosolids applied to agricultural and nonagricultural land (see Table 3-2). For predicting biosolids generation, EPA assumes that 1,400 pounds of biosolids are generated for each million gallons of wastewater processed (Metcalf & Eddy, 1972).

3.3 Water Quality Criteria (WQC)

EPA obtains the ambient criteria (or toxic effect levels) for the protection of aquatic life and human health from a variety of sources including EPA criteria documents, EPA's Assessment Tools for the

[1] 40 CFR Part 503, Standards for the Use or Disposal of Sewage Sludge, Final Rule (February 19, 1993).

Table 3-1. POTW Removals and Biological Inhibition Concentrations

Pollutant	% POTW Removal [a]	Biological Inhibition Concentration (mg/L)[b]	Pollutant	% POTW Removal [a]	Biological Inhibition Concentration (mg/L)[b]
aluminum	17	N/A	acetophenone	95	N/A
antimony	71	N/A	alpha-terpinol	94	1000
arsenic	91	0.04	anthracene	96	5
barium	90	N/A	benzene	95	5
boron	70	10	benzo(a)anthracene	98	500
cadmium	90	0.5	benzo(a)pyrene	95	500
calcium	52	N/A	benzo(b)fluoranthene	95	500
chromium	93	0.1	benzo(k)fluoranthene	95	500
cobalt	4.8	N/A	benzoic acid	81	5
copper	88	0.1	benzyl alcohol	78	1000
iodine	39	N/A	biphenyl	96	N/A
iron	83	5	bis(2-ethylhexyl) phthalate	60	10
lead	92	0.1	bromodichloromethane	92	N/A
lithium	26	N/A	butanone	97	150
magnesium	32	N/A	butyl benzyl phthalate	94	10
manganese	41	10	carbazole	85	1
mercury	92	0.1	carbon disulfide	84	N/A
molybdenum	52	N/A	chlorobenzene	97	5
nickel	58	1	chloroform	77	150
phosphorus	69	N/A	chrysene	97	500
potassium	20	N/A	di-n-butyl phthalate	79	10
selenium	34	N/A	dibenzofuran	85	500
silicon	27	N/A	dibenzothiopene	85	500
sodium	52	N/A	diethyl ether	7	N/A
strontium	15	N/A	diethyl phthalate	60	10
sulfur	14	N/A	diphenyl ether	98	1
tin	65	N/A	diphenylamine	79	1
titanium	69	N/A	ether	52	1000
zinc	79	0.3	ethyl benzene	94	5
1,1,1,2-tetrachloroethane	23	N/A	fluoranthene	42	500
1,1,1-trichloroethane	92	150	fluorene	70	5
1,1,2-trichloroethane	75	N/A	hexanoic acid	84	N/A
1,1-dichloroethane	81	N/A	isophorone	62	N/A

Table 3-1. (Continued)

Pollutant	% POTW Removal [a]	Biological Inhibition Concentration (mg/L)[b]	Pollutant	% POTW Removal [a]	Biological Inhibition Concentration (mg/L)[b]
1,1-dichloroethene	89	150	m-xylene	99	5
1,2,3-trichloropropane	5	N/A	methylene chloride	55	150
1,2,4-trichlorobenzene	92	0.1	n-decane	9	150
1,2-dibromoethane	17	N/A	n-dodecane	95	150
1,2-dichlorobenzene	89	0.1	n-eicosane	92	150
1,2-dichloroethane	89	150	n-hexadecane	71	150
1,3-dichlorobenzene	89	0.1	n-octadecane	71	150
1,4-dichlorobenzene	52	0.1	n-tetradecane	71	150
1-methyl fluorene	88	5	N.N-dimethylformamide	85	150
1-methylphenanthrene	88	5	naphthalene	96	5
2,3,4,6-tetra chlorophenol	33	N/A	o+p xylene	95	5
2,3-benzofluorene	88	500	o-cresol	53	N/A
2,3-dichloroaniline	41	N/A	p-cresol	72	N/A
2,4,5-trichlorophenol	28	N/A	p-cymene	99	5
2,4,6-trichlorophenol	65	N/A	pentachlorophenol	14	N/A
2,4-dimethylphenol	99	N/A	pentamethylbenzene	92	5
2-butanone	92	150	phenanthrene	95	5
2-chlorophenol	85	N/A	phenol	97	90
2-hexanone	88	N/A	pyrene	84	500
2-methylnaphthalene	28	5	pyridine	95	1
2-phenylnaphthalene	88	5	tetrachloroethene	83	150
2-picoline	85	N/A	tetra chloromethane	92	N/A
2-propanone	84	150	toluene	97	5
3,6-dimethyl phenanthrene	88	5	trans-1,2-dichloroethene	79	N/A
4-chloro-3-methylphenol	63	N/A	trichloroethene	93	150
4-methyl-2-pentanone	88	150	trichlorofluoromethane	98	N/A
acenaphthylene	99	5	tripropyleneglycolmethyl	52	1,000
acenapthene	98	5	vinyl chloride	93	N/A

a. Calculation is detailed in Chapter 7 of the technical development document

b. The lowest reported concentration at which the activated sludge process is inhibited. EPA evaluated POTW operations using facility-specific data and information derived from the sources described in Sections 3.1 and 3.2. The individual loadings from CWT facilities that discharge to the same POTW were summed before the POTW influent and biosolids concentrations are calculated.

Table 3-2. POTW Biosolids Pollutant Concentration Criteria[d]

Pollutant	Pollutant Ceiling Values [a] (mg/kg)	Pollutant Concentration Limit Values [b] (mg/kg)
Arsenic	75	41
Cadmium	85	39
Copper	4,300	1,500
Lead	840	300
Mercury	57	17
Molybdenum	75	35 [c]
Nickel	420	420
Selenium	100	36
Zinc	7,500	2,800

a. Maximum concentration permitted for land application of biosolids.
b. Concentration limit for continuous unlimited land application of biosolids.
c. The standard used for molybdenum is 35 mg/kg (59 *Federal Register* 9095, February 18, 1994). EPA notes that the PCL value for molybdenum was deleted from Part 503 effective February 19,1994. EPA will consider establishing a limit at a later date.
d. Referenced from 40 CFR Part 503 3-3

Evaluation of Risk (ASTER), and EPA's Integrated Risk Information System (IRIS, USEPA 1997a) uses ecological toxicity estimations when there are no available published values. The following subsections describe the hierarchies used to select the appropriate aquatic life and human health values.

3.3.1 Aquatic Life

EPA has established water quality criteria for many pollutants for the protection of freshwater aquatic life (acute and chronic criteria). The acute value represents a maximum allowable 1-hour average concentration of a pollutant at any time and can be related to acute toxic effects on aquatic life. The chronic value represents the average allowable concentration of a toxic pollutant over a 4-day period at which a diverse

group of aquatic organisms and their uses should not be unacceptably affected, provided that these levels are not exceeded more than once every 3 years.

EPA uses specific toxicity values[2] for pollutants for which no water quality criteria have been developed. In selecting values from the literature, EPA prefers measured concentrations from flow-through studies under typical pH and temperature conditions. The test organism must be a North American resident species of fish or invertebrate. The hierarchies used to select the appropriate acute and chronic values are listed below in descending order of priority.

Acute Aquatic Life Values:

- National acute freshwater quality criteria
- Lowest reported acute test values (96-hour LC_{50} for fish and 48-hour EC_{50}/LC_{50} for daphnids)
- Lowest reported LC_{50} test value of longer duration, adjusted to estimate a 96-hour exposure period
- Lowest reported LC_{50} test value of longer duration, up to a maximum of 2 weeks exposure
- Estimated 96-hour LC_{50} from the ASTER QSAR model

Chronic Aquatic Life Values:

- National chronic freshwater quality criteria
- Lowest reported maximum allowable toxic concentration (MATC), lowest observable effect concentration (LOEC), or no observable effect concentration (NOEC)
- Lowest reported chronic growth or reproductive toxicity test concentration
- Estimated chronic toxicity concentration from a measured acute chronic ratio for a less sensitive species, quantitative structure activity relationship (QSAR) model, or default acute: chronic ratio of 10:1

[2] Acute and chronic effect concentrations reported in published literature or estimated using various application techniques.

3.3.2 Human Health

EPA has established water quality criteria for the protection of human health based on a pollutant's toxic effects, including carcinogenic potential. EPA has developed these human health criteria values for two exposure routes: (1) ingesting the pollutant via contaminated aquatic organisms only, and (2) ingesting the pollutant via both contaminated water and aquatic organisms. These equations are as follows:

For Toxicity Protection (ingestion of organisms only)

$$HH_{oo} = \frac{RfD \times CF}{IR_f \times BCF} \qquad \textbf{(Eq. 12)}$$

where:

HH_{oo}	=	human health value (μg/L);
RfD	=	reference dose (mg/day);
IR_f	=	fish ingestion rate (0.0065 kg/day);
BCF	=	bioconcentration factor (L/kg); and
CF	=	conversion factor (1,000 μg/mg).

For Carcinogenicity Protection (ingestion of organisms only)

$$HH_{oo} = \frac{BW \times RL \times CF}{SF \times IR_f \times BCF} \qquad \textbf{(Eq. 13)}$$

where:

HH_{oo}	=	human health value (μg/L);
BW	=	body weight (70 kg);
RL	=	risk level (10^{-6});
SF	=	cancer slope factor $(mg/kg/day)^{-1}$;

IR_f	=	fish ingestion rate (0.0065 kg/day);
BCF	=	bioconcentration factor (L/kg); and
CF	=	conversion factor (1,000 μg/mg).

For Toxicity Protection (ingestion of water and organisms)

$$HH_{wo} = \frac{RfD \ x \ CF}{IR_w + (IR_f \ x \ BCF)} \qquad \textbf{(Eq. 14)}$$

where:

HH_{wo}	=	human health value (μg/L);
RfD	=	reference dose (mg/day);
IR_w	=	water ingestion rate (2 liters/day);
IR_f	=	fish ingestion rate (0.0065 kg/day);
BCF	=	bioconcentration factor (L/kg); and
CF	=	conversion factor (1,000 μg/mg).

For Carcinogenic Protection (ingestion of water and organisms)

$$HH_{wo} = \frac{BW \ x \ RL \ x \ CF}{SF \ x \ [\ IR_w + (IR_f \ x \ BCF) \ ]} \qquad \textbf{(Eq. 15)}$$

where:

HH_{wo}	=	human health value (μg/L);
BW	=	body weight (70 kg);
RL	=	risk level (10^{-6});
SF	=	cancer slope factor $(mg/kg/day)^{-1}$;
IR_w	=	water ingestion rate (2 L/day);
IR_f	=	fish ingestion rate (0.0065 kg/day);
BCF	=	bioconcentration factor (L/kg); and
CF	=	conversion factor (1,000 μg/mg).

EPA derives the values for ingesting specific pollutants by drinking contaminated water and/or eating contaminated aquatic organisms by assuming an average daily ingestion of 2 liters of water, an average daily fish consumption rate (16.6 and 140 grams per day of fish products for recreational and subsistence anglers, respectively), and an average adult body weight of 70 kilograms (USEPA, 1989 a).

If a pollutant of concern has a cancer slope factor, then EPA uses values protective of carcinogenicity to assess the pollutant's potential effects on human health. EPA develops protective concentration levels for carcinogens in terms of non-threshold lifetime risk level. This analysis relies on criteria at a risk level of 10^{-6}. This risk level indicates a probability of one additional case of cancer for every 1,000,000 persons exposed. Toxic effects criteria for non-carcinogens include systemic effects (e.g., reproductive, immunological, neurological, circulatory, or respiratory toxicity), organ-specific toxicity, developmental toxicity, mutagenesis, and lethality.

The hierarchy used to select the most appropriate human health criteria values is presented below in descending order of priority:

- Calculated human health criteria values using EPA's IRIS RfDs or SFs used in conjunction with adjusted 3 percent lipid BCF values derived from *Ambient Water Quality Criteria Documents* (USEPA, 1987b); 3 percent is the mean lipid content of fish tissue reported in the study from which the average daily fish consumption rates are derived.
- Calculated human health criteria values using current IRIS RfDs or SFs and representative BCF values for common North American species of fish or invertebrates or estimated BCF values.
- Calculated human health criteria values using RfDs or SFs from EPA's Health Effects Assessment Summary Tables (HEAST) used in conjunction with adjusted 3 percent lipid BCF values derived from *Ambient Water Quality Criteria Documents* (USEPA, 1987b).
- Calculated human health criteria values using current RfDs or SFs from HEAST and representative BCF values for common North American species of fish or invertebrates or estimated BCF values.
- Criteria from the *Ambient Water Quality Criteria Documents* (USEPA, 1987b).
- Calculated human health values using RfDs or SFs from data sources other than IRIS or HEAST.

This hierarchy is based on Section 2.4.6 of the *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a). This document recommends using the most current risk information from IRIS when estimating human health risks. In cases where chemicals have both RfDs and cancer SFs from the same level of the hierarchy, EPA calculates human health values using the formulas for carcinogenicity, which always results in the more stringent value of the two given the risk levels employed.